

EARLY CAMBRIAN "JELLYFISHES" OF EDIACARA, SOUTH AUSTRALIA AND MOUNT JOHN, KIMBERLEY DISTRICT, WESTERN AUSTRALIA

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[Read 8 September 1949]

ABSTRACT

The richly fossiliferous horizon within the Pound Sandstone, near the base of the Cambrian in South Australia, has provided more new material. With the additional specimens it has been possible to classify several new forms with considerably more reliability. Some very close resemblances with modern genera have been established and the classification of most forms as coelenterates and even as members of either the Hydrozoa or Scyphozoa seems beyond question. One specimen is remarkably similar to the modern *Dipleurosoma*. A form from an equivalent horizon in the Kimberley or North-West Division of Western Australia collected by Dr. A. Wade is also described and included within the *Hydrozoa*. This latter remarkable form buds daughter medusae at its margin very similarly to the living *Niobia dendrotentacula*.

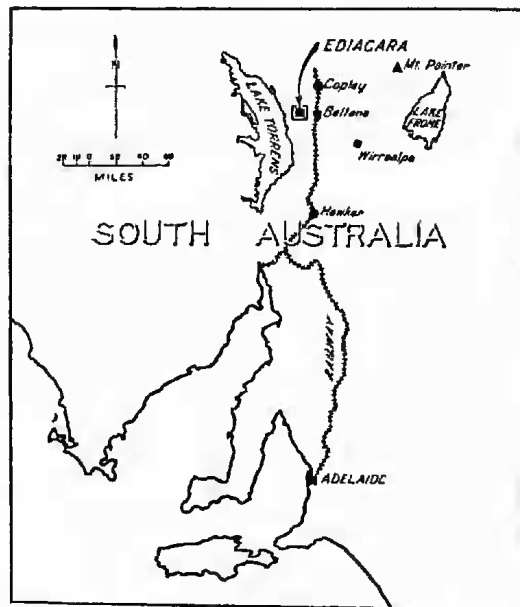


Fig. 1

INTRODUCTION

Since the original discovery and publication of a short report on supposed jellyfish from Ediacara in South Australia, the locality has been visited by Sir D. Mawson and a party of students from the Adelaide University, and again by the writer accompanied by Dr. Curt Teichert. Altogether much new material has been forthcoming, and now nearly 100 fine specimens of (?) pelagic fossils are available from the locality.

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As far as could be ascertained, all the forms collected by the writer came from a single stratigraphic horizon or within a few feet of it. Obviously the particular parting in the fissile quartzites in which the forms occurred is packed with such impressions. The author collected more than 50 specimens in less than three hours, indicating the abundance of the forms. The horizon has been traced for about three miles on the western side of an elongated synclinal basin. Several distinct new forms were discovered, and a form originally described from a single specimen (*Dickinsonia costata*) has proved particularly common. Professor Mawson has indicated that he found evidence of two distinct fossiliferous horizons (personal communication) in the northern extensions of the fossil occurrences.

There can now be no doubt as to the fossils' organic origin, nor can there be any hesitation in placing many of the forms with either the Hydrozoa or Scyphozoa of the Coelenterata. Some forms are referable to Algae, but these will not be described in this paper.

In the previous paper (1947) it was postulated that the environmental associations of the fossils and the local palaeogeography demonstrate tidal flat or at least coastal conditions. This opinion still holds, and practically all forms yet discovered appear to be pelagic; some were obviously free swimming. Such a state of affairs is in keeping with general theories of life at the end of the Precambrian. It has been suggested that most animals were then pelagic, and possibly were only just "discovering" the sea floor preparatory to colonizing it (Hinde 1939).

Whatever the true facts, it does appear fairly definite that with the exception of a few lime-secreting algae, most animals until this time produced few hard parts and then usually chitinous. It is little wonder then that the fossil record below the base of the Cambrian is so devoid of fossils.

The Upper Precambrian has been termed an age of jellyfishes mainly upon evolutionary considerations, but also in view of discoveries from the Cambrian of New York, Sweden, Russia and Bohemia. From consideration of faunal associations of the Cambrian, such assumptions for the immediate Precambrian are quite logical.

There is no need to discuss further the question of the stratigraphical situation of the horizon, as the arguments were summarized in the previous publication and no evidence has been forthcoming since then. The close association with Archaeocyathinae (Pleospongia) leaves little doubt concerning their Lower Cambrian age.

The mode of occurrence and aspects of preservation have also been discussed previously and little need be added here. It should be remembered that Agassiz (1862), in his observations of *Aurelia flavida*, noted that after the spawning period there was a thickening of the tissues by an increased deposition of animal substance. The disc of the animal became thin and almost leathery and more elastic than before. Many marginal appendages of the umbrella and oral region dropped off.

Caster (1945) noted that when *Aurelia* and other medusae were stranded onshore in midsummer, they quickly dried out on the surface. The dehydration of the aqueous jelly brought out in surface relief embedded structures, which in life would be hardly discernible, except by transparency at the exterior. These latter observations are extremely important in considering the present fossil forms.

The stranding of huge numbers of jellyfish high on beaches during strong winds is frequently observed in many parts of the world at the present day. Hence it is not surprising that once favourable conditions for preservation are

established large numbers of the forms may become fossilized in a somewhat restricted area. It should be also borne in mind that in Post-Cambrian times with increased number and variety of sea-shore scavengers the possibility of preservation was considerably reduced; sea birds would quickly destroy stranded jellyfish and the chances of fossilization were therefore particularly remote.

PROBLEMS OF THE CLASSIFICATION OF THE FOSSILS

In view of Agassiz' and Caster's various observations, classification on the zoological system is obviously hazardous. Where marginal or manubrial appendages are concerned there is need for particular caution, and obviously completely satisfactory relationships will rarely be possible. However, in some cases, manubrial structures, stomachs, gonads, radial and circular canals, and marginal notches are reasonably well defined. In two cases, delicate velar membranes are exquisitely preserved, and in the fossil from Kimberley there is clear evidence of marginal budding. For this reason the modern zoological classification will be followed wherever possible and the system as outlined by Parker and Haswell (1940) will be adhered to with only slight modification. Obviously, detailed classifications of zoologists will be modified slightly to admit even the more completely preserved forms. In many cases diagnostic characters are not present which would allow even a broad classification, while in others, close relationships with other living forms are obvious. The writer has gone so far as to relate one form closely to a modern genus by erecting the subgenus *Protodipleurosoma*, and although the wisdom of this may be questioned, it does serve to illustrate the remarkably faithful preservation of the fossil. Still another form (*Wadeia*) can be related closely to a living genus (*Niobia*) and another placed fairly confidently in a modern family (e.g., *Beltanella* in family Trachylinae). Others can be located with reasonable assurance in modern orders or classes, while still another group are of decidedly uncertain affinities.

Another group of fossils which it may be argued should more correctly be placed with the problematica are those thought to represent the oral regions of Rhizostomeae. The striking similarity of patternation of the fossil furrows with the mouth groove system of animals of that highly specialized group is thought to warrant such classification.

Additional complexity is brought about by a possible general tendency to degeneration and simplification over the great geological periods down to the present. Forms which were large and impressive in Cambrian times may now be quite insignificant. This appears to have been the case with both *Beltanella gilesi* and *Protodipleurosoma wardi*. Their assumed modern relatives measure only a fraction of an inch (a few mm.) in diameter and would scarcely be noticed when washed upon a beach. The related fossil forms measured several inches (50-100 mm.) in diameter and were therefore of the order of "modern" scyphozoan medusae.

As only to be expected, it appears almost certain that all modern orders of "jellyfishes" were represented by the beginning of the Cambrian. There were probably other orders that have since become extinct or which were intermediate between and ancestral to two or more modern orders. With such possibilities, classification of the fossil forms must be tentative to some extent and dependent upon the discovery of new and more completely preserved material.

TENTATIVE CLASSIFICATION AND DESCRIPTION OF THE FOSSILS

All forms described in the present paper appear to be most satisfactorily placed in the phylum Coelenterata and sub-phylum Cnidaria. The Cnidaria include all Coelenterates except the Ctenophores (or Comb-jellies).

The following brief notes which have been extracted from "The Invertebrates—Protozoa through Ctenophora" (Lyman, 1940) will serve to summarise some of the principal features of the subphylum.

The chief feature of the Cnidaria subphylum is the possession of striking radial symmetry. In one group, the Anthozoa, this is modified into biradial or radiobilateral symmetry brought about by elongation of the mouth and other correlated changes.

There is one principal axis of symmetry, namely, the oral-aboral axis, which extends from the mouth to the base, and the organs are arranged concentrically about this axis. The body structures may be definite or indefinite in number, and when definite the number is four or six or multiples thereof. Tentacles are very conspicuous, extensible projections that encircle the oral end in one or more whorls and serve for defence and feeding purposes; they are absent in very few members of the subphylum.

Cnidaria are notable for their di-morphism—the polyp and the medusa—each of which can be derived from the other giving an alternation of generations. The polyp is the sessile form, being vase-shaped and fastened at the aboral end with mouth and tentacles at the free or oral end. The medusa, or free swimming form, contrasts with the polyp in the shortening of the oral-aboral axis, radial expansion and in the excessive formation of mesogloea. The resulting form is a gelatinous bell- or saucer-shaped animal with marginal tentacles. Polyp and medusa occur in several morphological variations, several of which may be found in a single species. In the class hydrozoa, both polypoid and medusoid forms are present; in the scyphozoa, the medusoid is dominant, while the anthozoa are exclusively polypoid. Where a species includes both polypoid and medusoid forms the polyps reproduce exclusively by asexual methods and bud off the medusae or their equivalents which alone are capable of sexual reproduction. In this way there is an alternation of generation—an asexual polypoid generation and a sexual medusoid generation. It is thought probable that the polyp is a persistent form and the medusa the completely evolved coelenterate.

In the Hydrozoa and Scyphozoa all diameters are apolar, that is, any two diameters selected at right angles will be alike. In the Anthozoa, however, the radial symmetry tends to be strongly modified in biradial or bilateral fashion chiefly due to the elongation of the mouth and associated structures. In biradial symmetry the diameters remain apolar, but the long or sagittal axis differs from the transverse axis at right angles to it. Each divides the animal into like halves, as there is no dorsal or ventral surface. In many Anthozoa the sagittal axis is heteropolar with the two ends unlike. Dorsal and ventral surfaces are then definable.

In the fossil forms to be described most have characteristic radial symmetry allying them with the Hydrozoa or Scyphozoa. In a few forms, in particular *Dickinsonia*, there is a strong biradial tendency and the systematic classification of these is more difficult, the more so as the fossils possess so few features of diagnostic value. It has been suggested elsewhere in this paper that the bilateral tendency may indicate the assumption of creeping habit. It is quite possible that this fossil may be representative of a class now extinct.

In attempting to place the various fossils systematically within some system of Zoological classification much must remain tentative. The system given herein is essentially a summary of that of Parker and Haswell (1940) and the placing of the present fossils is indicated as far as possible keeping in mind that in many instances the restricting criteria, as indicated in the keys, have not been observed. In such cases, classification has been made by making use of certain general similarities with modern genera and species.

In this manner it has been found possible to place most of the forms reasonably satisfactorily; a few forms have had to be relegated to Walcott's genus of convenience, *Medusina*. This genus was erected to include all species of fossil medusae whose generic characters were indeterminable. In making use of this genus it is realised that there are arguments for also including some of the forms tentatively placed with the Discomedusae.

Phylum COELENTERATA

Sub-Phylum CNIDARIA

Class HYDROZOA

Order *Hydroidea*—Hydrozoa in which there is a fixed zoophyte stage.

Sub-order *Anthomedusae*. In which the medusae bear the gonads on the manubrium, a.e., *Protomiobia wadea* (cf., modern *Niobia dendrotentacula*.)

Sub-order *Leptomedusae*. In which the gonads occur in relation with the radial canals, e.g., *Protodipleurosoma wardi* (cf. modern *Dipleurosoma*).

Order *Trachylinae*—Hydrozoa with no known fixed zoophyte stage.

Sub-order *Trachymedusae*. Veiled medusae with simple entire bell margin not cleft into lappets. This is a distinguishing feature from the Narcomedusae. Tentacles spring from the margin of the umbrella and the gonads are developed in connection with the radial canals, e.g., *Beltanella gilesi* (cf., modern *Rhopalonema*).

Sub-order *Narcomedusae*—in which tentacles spring from the exumbrella some distance from the margin, and the gonads are developed in connection with the manubrium.

Order *Siphonophora*—Hydrozoa in which the colony usually exhibits extreme polymorphism of its zooids. There may be strong bilateral symmetry.

Class SCYPHOZOA

Order *Lucernaridae* (*Stauromedusae*). Scyphozoa with a conical or vase-shaped umbrella mostly attached to external objects by an exumbrella peduncle. No tentaculocysts.

Order *Coronata*. Scyphozoa with the umbrella divided by a horizontal coronary groove. Four to sixteen tentaculocysts.

Order *Cubomedusae*. Scyphozoa with a four-sided cup-shaped umbrella. Four per-radial tentaculocysts.

Order *Discomedusae* (*Semaeostomeae*). Scyphozoa with flattened saucer-shaped umbrella and not fewer than eight tentaculocysts. The square mouth produced into four long oral arms, e.g., *Ediacaria flindersi*, *Tateana inflata*.

Order *Rhizostomeae*—Scyphozoa having the mouth obliterated by growths across it of the oral arms. Stomach is continued into canals which open by funnel-shaped apertures on the edges of the arms, e.g., *Pseudorhizostomites* and *Pseudorhopilema*.

Medusoid Problematica. Category *Medusina*—Medusae whose generic characters cannot be determined, e.g.: *Medusina mawsoni*, *M. asteroides*, *M. filamentis*, *Cyclomedusa davidi*, *C. radiata*, *C. gigantea*, *Madigania annulata*, *Dickinsonia costata*, *D. minima*.

Order HYDROIDEA — Sub-order ANTHOMEDUSAE

Genus *Protoniobia* Sprigg gen. nov.

Genotype *Protoniobia wadea* Sprigg, gen. et. sp. nov. Lower Cambrian flags, Mount John, Osmond Range, Western Australia.

Genus monotypic, generic characters include the circular form, the close association of the six (?) gonads with the stomach, and the development of medusae by a process of budding from the margin of the form.

Protoniobia wadea, Sprigg gen. et sp. nov.

(Plate ix, fig. 1, and text fig. 2)

Holotype: No. 192, Bureau of Mineral Resources, Canberra, F.C.T. Coll. Dr. A. Wade.

Description—Impression circular, with few prominent annular undulations. Near the centre of the form numerous nodular structures are arranged in a polygonal pattern about a central depressed zone. The nodular structures occur on a slightly wider platform, which in turn is surrounded by a deep circular groove without conspicuous ornamentation. Beyond the latter are annular ridges separated by a second deep groove. This latter groove gives some evidence of secondary sculpturing which may bear relationships to inferred radial canals.

At the margin of the umbrella impression there form sub-circular structures of uneven development which are arranged in an incomplete hexagonal pattern. The bud-like "appendages" have a concentric form within themselves and show an apparent resemblance with the "parent" impression. There are no tentacles present.

Dimension—Maximum diameter of the bell 4.1 mm.; average diameter of (?) gonadial nodes 2.5 mm.; maximum diameter of largest "bud" 1.4 mm.

Discussion and affinities—The specimen is the impression of a medusa. The numerous nodular subcentral nodes are probably gonadial structures, in close association with a circular stomach, and it is just possible that the inner of the two outer annular ridges may be a velar structure.

The circular marginal structures of the form are peculiar features which at first sight may suggest coiled tentacles, and probably prompted the original description of this fossil by Dr. Wade (1924) as a "coiled (?) gephyrean or unsegmented worm." (The impression is not spiral and is almost certainly coelenterate. However, closer inspection of the fossil shows that the marginal structures are essentially circular with annular internal patternation.)

One apparently modern parallel is known to the author, namely the unique *Niobia dendrotentacula* (Mayer 1900) of the Tortugas, Florida. Marginal tentacles of this species develop into medusae by a peculiar process of budding combined with fortuitous growth, and are set free into the water as independent animals similar to the parent medusae.

According to Mayer (1910, pp. 187, 188), *Niobia dendrotentacula* is slightly flatter than a hemisphere and about 4 mm. in diameter. "There are 12 marginal tentacles, one at the foot of each radial canal and one intermediate between each successive pair of radial canals. These 12 tentacles are arranged in a bilaterally symmetrical manner in accordance with age. The oldest and the youngest tentacles are situated at the ends of the two simple radial canals and the remaining ten tentacles are arranged in bilateral symmetry in accordance with their various ages, the axis being in the diameter of the two simple radial canals and the oldest and youngest tentacles. Each half of the margin is thus a reflection of the other. . . ." The order in age of each tentacle is shown in fig. 2 D. "The oldest tentacle is the first to develop into a medusa and be set free, and the others follow in the order of their age until all of the tentacles have been cast off. They

are immediately replaced, however, by new tentacles, but after every one of the original 12 tentacles has been developed into a new medusa, the process of forming medusae declines and finally ceases, and then the parent medusa becomes sexually mature. . . ." The gonads occupy four interradial situations in the upper part of the ectodermal wall of the stomach. After the budding medusae have been set free the gonads become mature and the ova are large and project from the interradial surfaces of the stomach. They are finally dehisced into the water."

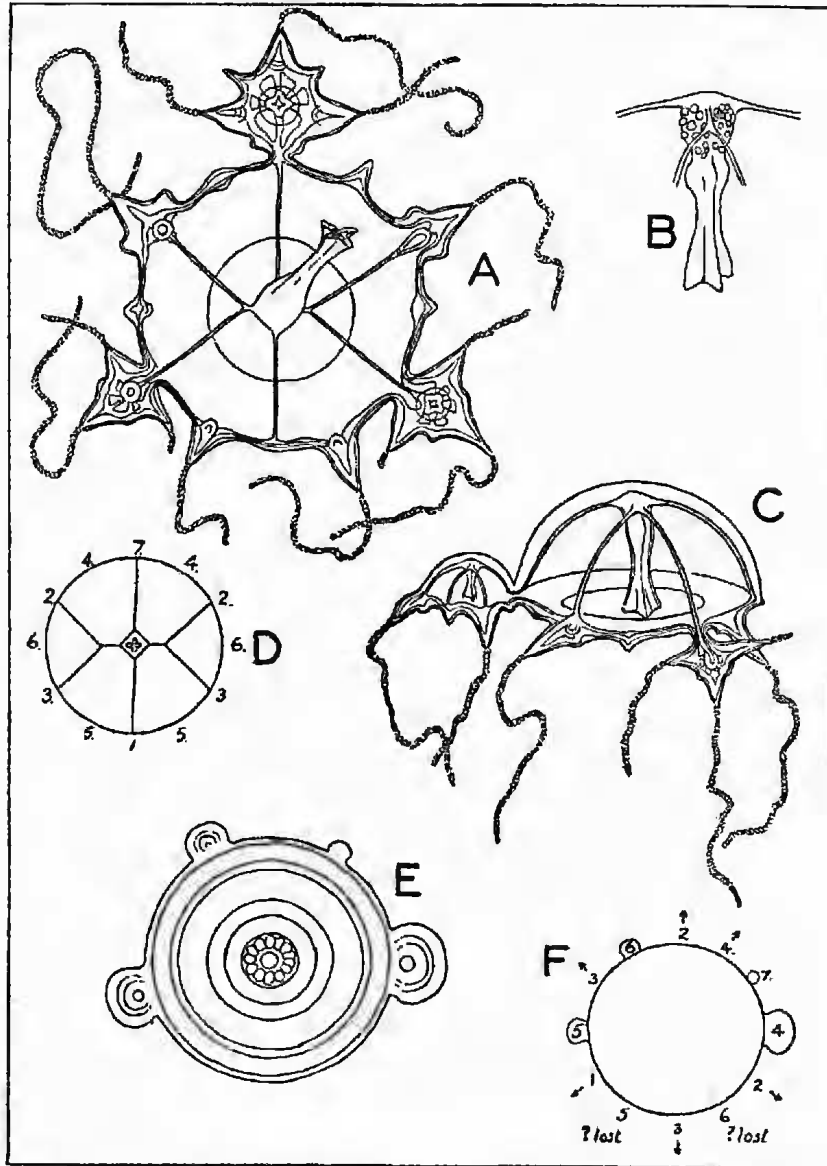


Fig. 2

A—D, *Niobia dendrotentacula*: A, oral view; B, detail of manubrium bearing the gonads; C, side view; D, budding sequence. E and F, *Protonobia wadea*: E, the fossil; F, bud diagram.

In the present fossil there is an obvious unequal development of buds, but with only the one well preserved specimen it is impossible to determine the complete sequence of the animal. Certainly there is a pseudo-hexagonal arrange-

ment of the buds as in the case of *Niobia*, and it is perhaps legitimate to infer a rather similar life history. The two forms may be linearly related and a good case for parallel development of the buds can be made out.

In the fossil form the two adjacent buds on the upper margin (fig. 2 E) are of approximately equal development, while the two diametrically opposed buds are larger and unequally developed. Such an arrangement cannot be matched *exactly* however the form is orientated or in whatever stage of development the fossil was entombed. If, though, the interpretation of the subcentral nodular structures as gonads is correct, then it may be fairly assumed that the form was approaching sexual maturity. In this case it is possible that the animal had reached a stage where the largest bud was in stage 4, the diametrically opposite one in stage 5, and the two smaller ones in stages 6 and 7. The buds in stages 1, 2 and 3 presumably would have been freed.

A second example of *Protoniobia* has been discovered amongst material from Ediacara. The fossil is slightly smaller, its bell being about 20 mm. in diameter. There is evidence of four daughter buds. The example occurs on the same quartzite fragment as fossil No 2010. Its discovery supports the view that the Kimberley fossil was approximately contemporaneous with the Ediacara suite.

Sub-order LEPTOMEDUSAE (Haeckel 1866)

The modern Leptomedusae are thought to be descended from the more simply organised Anthomedusae. These medusae are creatures of coasts and are rarely found far out to sea, for they cannot maintain themselves in situations unsuited to the growth of their hydroids.

Subdivision into families in the modern classification is based on the presence or absence of lithocysts and the number of radial canals. The placing of the fossil form in this instance is based on general morphological similarities with a particular living species.

Genus *Protodipleurosoma* Sprigg gen. nov.

Form similar to that of *Dipleurosoma* (Axel Boeck 1866) is observable features, but much larger. *Dipleurosoma* is characterised by three or more main radial canals, some of which give rise to nondichotomous branches. Gonads on the canals adjacent to the manubrium; monosexual.

Protodipleurosoma wardi Sprigg, sp. nov.

(Plate ix, fig. 2. and text fig. 3)

Holotype: No. 2093, Tate Museum Coll. Adel. Univ. S. Aust. Collected, R. K. Johns.

Description—Impression (bell) circular, flattened. Stomach subcircular constricted unevenly, lobate, radial canals developed irregularly, branched nondichotomously, only one can be seen reaching the circular canal, but preservation of the velum impression has obscured complete observation. Primary canals are strong and give rise to shorter secondary canals which may not reach the circular canal. Branching occurs near the bases of the primary canals. Ring canal circular, and about 2 mm. in from the margin of the fossil. There are no signs of marginal appendages. The velum is wide and well preserved. Gonads are not present and the example by comparison with related living forms is therefore probably male.

Dimensions—Major diameter of fossil 59 mm.; length of stomach 16 mm.

Discussion and comparisons—The fossil forms are remarkably similar to the living *Dipleurosoma hemisphaericum* (Allman), although the latter is usually only

about 10 mm. in diameter. The velum in the fossil species is relatively slightly wider and the stomach relatively very larger. Branching of the radial canals and the position of the ring canal agree very closely. Allman (1873), in his description, states that there are three main radial canals with branches; some of the branches enter the ring canal and others terminate blindly. It is noted that the sub-family Berenicinae as described by Mayer (1910) present all radial canals connecting with the circular canal.

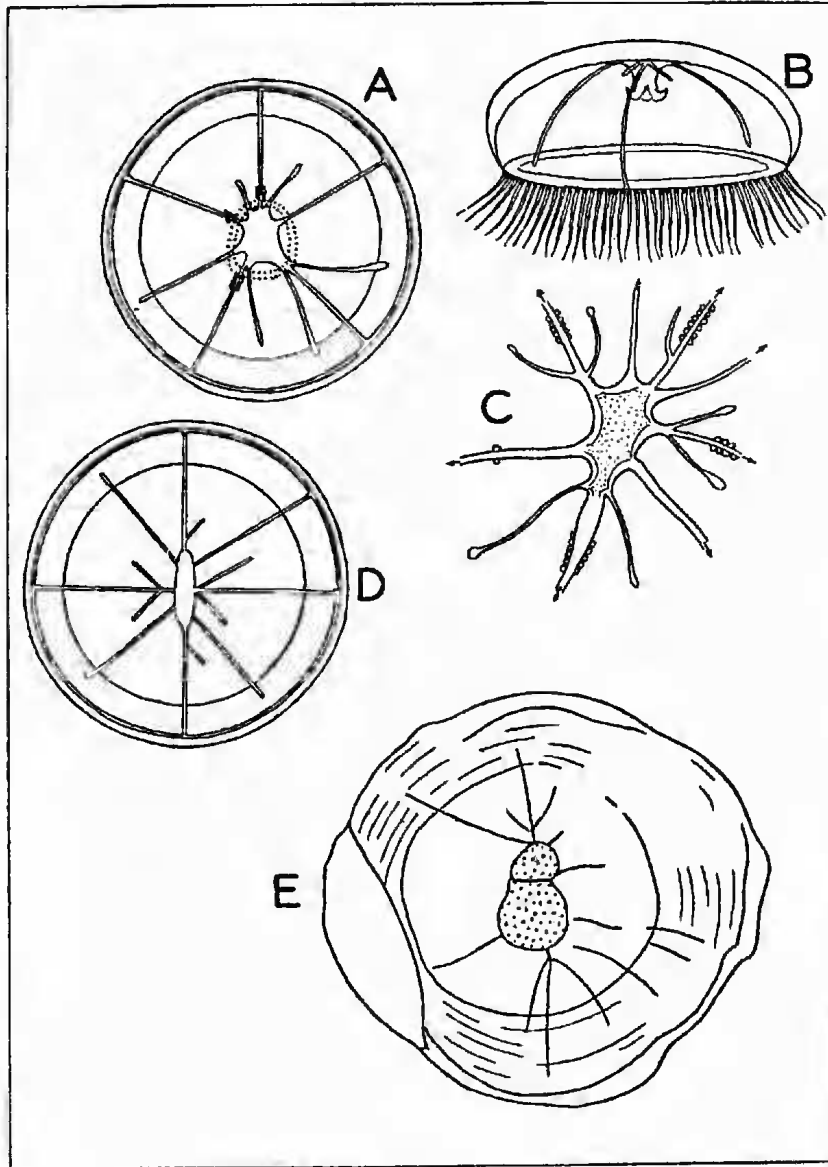


Fig. 3

A—D, details of the living *Dipleurosoma*; E, the fossil *Protodipleurosoma wardi*.

There can be little doubt that this fossil form is closely related to the genus *Dipleurosoma*. In life the fossil form was probably subhemispherical, free swimming, and considerably larger than its assumed modern descendants. It is also assumed that the species experienced an alternation of generation although nothing is known of its hydroid stage.

Order TRACHYLINAE

Suborder TRACHYMEDUSAE (Haeckel 1866)

Family (?) TRACHYNEMIDAE Gegenbaur 1856

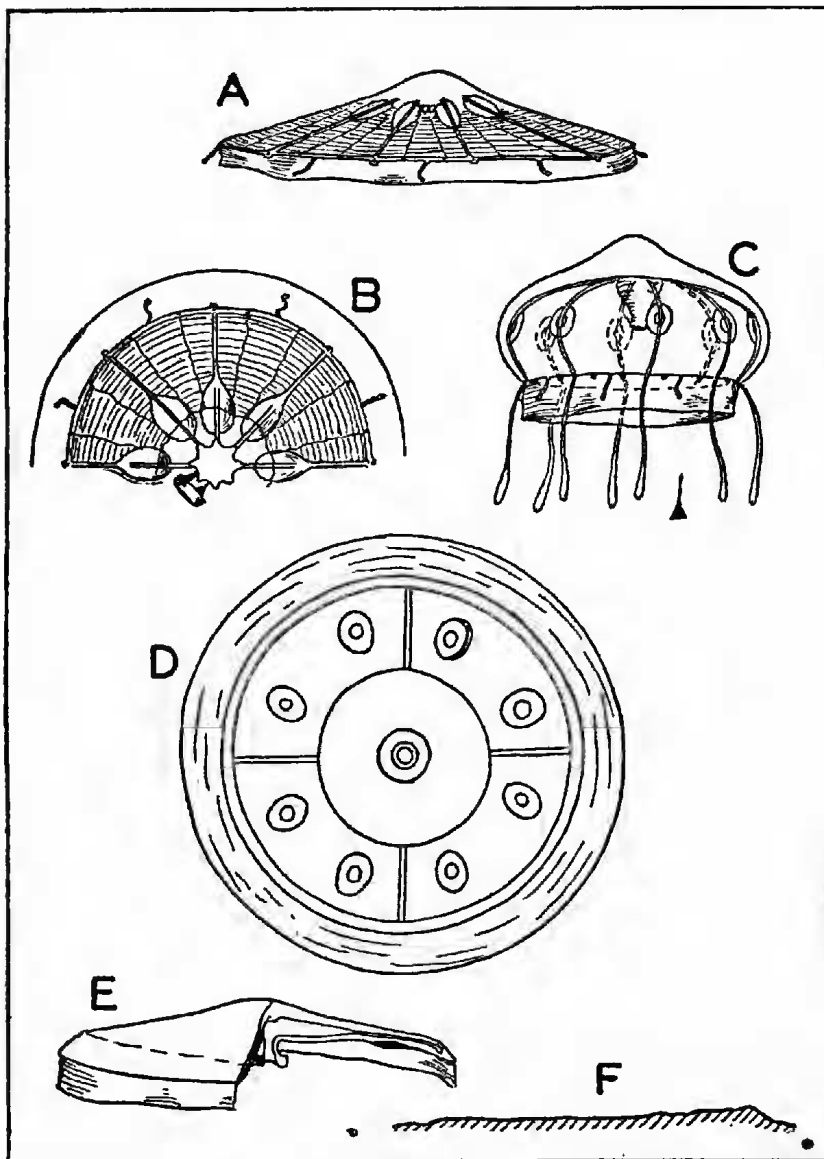
Trachymedusae with eight or more simple radial canals,
on some or all of which the gonads are developed.

Fig. 4

A. and B, *Rhopalonema striatum*; C, *R. velatum*, side view; D—F, *Beltanella gilesi*;
D, aboral view; E, side view with section removed; F, section through fossil.

Genus *Beltanella* Sprigg 1947Genotype: *Beltanella gilesi* Sprigg.

Pound Quartzite, Upper Adelaide System (Lower Cambrian), Ediacara, South Australia.

Being monotypic this genus shares the species traits described below. Generic characters include the octagonal arrangement of the circular gonads and their

(?) paired relation about the four radial canals; the presence of a well developed and expanded delicate peripheral umbral structure or velum, and the simple circular oral aperture.

***Beltanella gilesi*, Sprigg 1947**

(Plate x, fig. 1, and text fig. 4)

Holotype: No. 2056, Tate Mus. Coll., Adel. Univ., S. Aust.

Description—Medusa impression circular. Umbrella flat, but falling away sharply near its outer margin. (?) Velum horizontal, depressed approximately 4 mm. in relation to the flat ex-umbrella surface. Umbrella region subdivided into two zones by a faint annular groove as follows:

Inner Zone—Surface smooth, broken only by annular grooves, respectively 5 and 12 mm. in diameter at centre. Centremost area depressed very slightly. The whole zone corresponds with the original stomach.

Outer Zone—Surface dominantly flat, but slopes away steeply near the outer margin of the umbrella. This secondary sloping surface has the form of a highly truncate cone whose apical angle is approximately 80 degrees. Zone is characterised by the presence of circular (?) gonadial structures, approximately 10 mm. in diameter. These regular structures are arranged on either side of the major radial canals in an octagonal pattern centrally within the zone. At least four can be recognised and each has an inner concentric groove 3 to 4 mm. in diameter. Two paired radial grooves (?) canals) are diametrically opposed and a third set lies radially at right angles. The grooves pass intermediate between the (?) paired gonadial structures, but do not continue into the inner zone. The ex-umbrella surface is slightly irregular at the edge of the flat raised portion, but below where the conical surface meets the velum, the margin is smooth.

Velum—Structure marginal, obviously thin, well developed; undulose surface depressed; undulations annular in plan.

Dimensions—Maximum diameter of fossil 110 mm., minimum 97; widths along single radii of inner and outer zones and velum respectively 18-20, 21-23 and 10-14 mm.

Discussion—The specimen is the cast of the ex-umbrella surface (ab-oral) of a jellyfish.

The central zone corresponds with the gastrovascular cavity. At its margin it gives (paired) grooves which are interpreted as radial canals. There are no signs of subdivision within the cavity, and no indication of complicated manubrial structures. The simple circular grooves situated centrally may be oral structures, or possibly representative of a collapsed truncate gastric cone of the type which occurs in some jellyfish to aid in the even distribution of food to various parts of the animal's stomach.

The radial grooves of the outer zone are very probably radial canals, although it is not known why they should be paired. There is no sign of branch canals from them, nor is there present any groove suggestive of a circular canal. The circular (?) gonadial structures which are distributed evenly around the centre of this zone may be considered as paired in relation to the supposed radial canals and the central annular grooves of each gonadial structure may mark a genital operculum.

The peripheral velum is remarkably well preserved considering its obvious delicate nature; its contained annular undulations suggest ring muscles. Its expanded position in rest suggests that it swung to and fro within and without the bell cavity as the medusa swam.

Affinities—In the original description this form was placed very tentatively with the Scyphozoa, although it was recognised that many characters were primitive, and indicative of the Hydrozoa. The simple mouth, the presence of a few unbranched radial canals were considered to be Trachylinid (Hydrozoan) characters, while the flattened disc-shaped umbrella, its relatively large size, and the absence of large tentacles were thought to be more characteristic of the Scophozoa.

It is now considered that the presence or absence of marginal appendages in fossil jellyfish can have little significance, and as regards size, diameters of four inches and more are not unknown amongst Trachylinids. A more convincing point concerns the resemblance of the species with the modern *Rhopalonema*, Gengenbaur 1856 (Family Trachynemidae).

Rhopalonema characteristically possesses 8 radial canals, and 8 gonads occur upon restricted portions of these canals. *Beltanella* differs in that although it has 8 gonads lying opposite the central portions of radial canals, these gonads do not appear to be on the canals. Also, evidence of only 4 radial canals can be recognised. Nevertheless, *R. velatum* and *R. striatum* (fig. 4) do show some striking similarities. *R. velatum* possesses rounded gonads situated about half-way between the stomach and bell margin and associated with circular canals which give much the concentric appearance of the gonads in the fossil form. *R. striatum* in general external form approaches the fossil even more closely and is described as having the shape of a Chinese hat. Its velum is very wide and muscular and swings to and fro within and without the bell cavity as the medusa swims. It was noted also that the tentacles of *R. velatum* are very brittle and usually break off very readily. It would appear, therefore, that there is good reason to associate this form fairly closely with *Rhopalonema*, and therefore the order Trachymedusae.

Rhopalonema is distributed throughout the tropical and warm oceans of the world and may live on the surface or at depth.

Order (?) SEMAEOSTOMEAE (Discomedusae)

Genus *Ediacaria* Sprigg 1947

Genotype *EDIACARIA FLINDERSI* Sprigg 1947

Found Quartzite, Upper Adelaide Series (Lower Cambrian), Ediacara, South Australia.

Generic characters include the circular form, the bell-like manubrium, the simple circular stomach and association of the (?) gonads with the base of the manubrium. There are 4 and possibly 8 marginal notches.

Ediacaria flindersi Sprigg

(Plate x, fig. 2, and text fig. 5)

Holotype: No. T1, Tate Mus. Coll., Adel. Univ., S. Aust.

Description—Medusa impression circular, radially symmetrical; surface flattened, but with radial and concentric features of low relief. Three concentric zones are clearly distinguishable.

Inner zone—Manubrium bell-like, constricted near its junction centrally with the sub-umbrella surface and expanded distally. It lies over sideways and is compressed laterally. Length 15 mm., and maximum width (flattened) 14 mm. At least three pendant lobate pouches extend 9 to 11 mm. centrifugally from the base of the manubrium. Beyond these pouches the central zone is essentially smooth, although there is an incomplete concentric groove half-way to the zone margin.

Median zone—Surface smooth, somewhat inflated; zone delineated on inner and outer aspects by concentric grooves—one (or two) on the inner margin, and one deeper with associated minor and less regular grooves on the outer. Two well-marked radial grooves are present, while indistinct radial striations are more numerous.

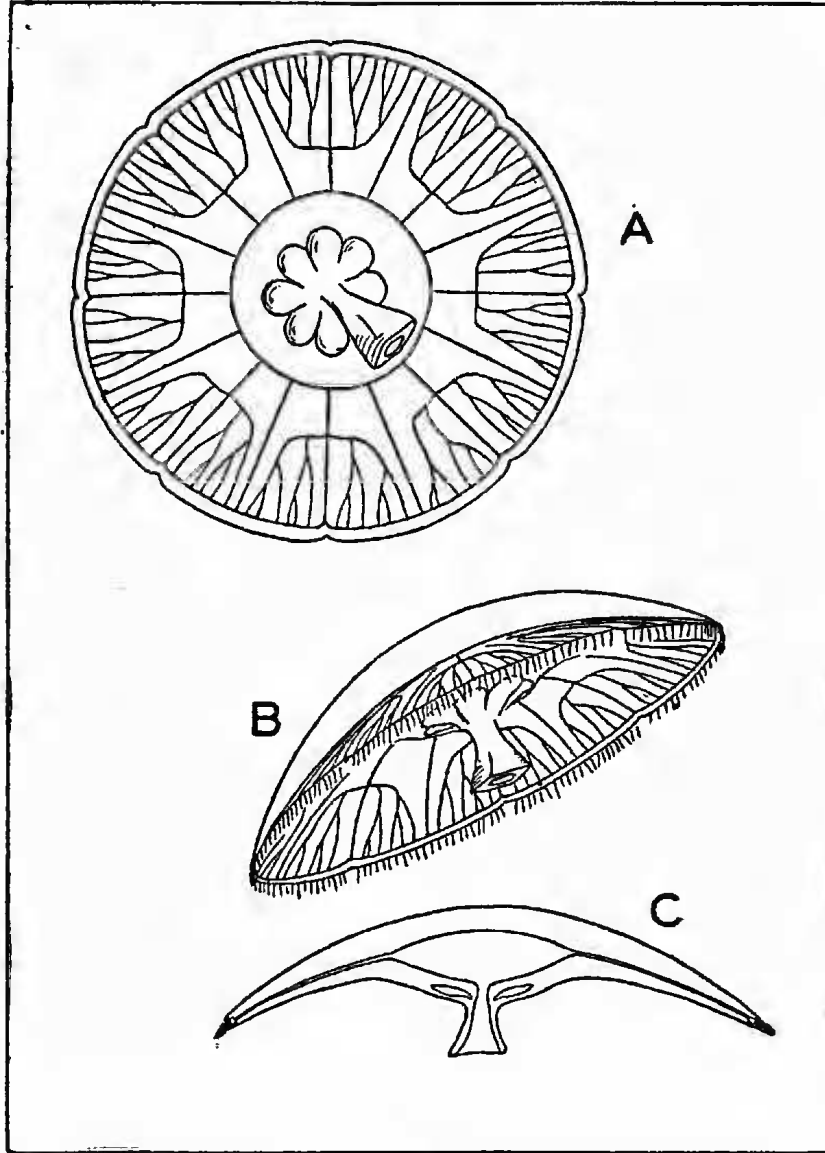


Fig. 5

Ediacaria flindersi, reconstructions: A, oral view; B, side view; C, cross section.

External zone—Surface flattened or only slightly convex in transverse section with minor concentric undulations or flutings and numerous radial grooves or striae. In the annular segment, representing three-fourths of the perimeter, at least 44 separate radial grooves can be recognised. Although somewhat irregular in themselves, they are distributed around the zone relatively evenly. Most diverge centrifugally, but some converge in this direction. The outer margin

(perimeter of fossil), is fairly regular (circular), with the exception of one or two doubtful marginal notches. A concentric groove lies approximately 4 mm. in from the perimeter of the form. The radial striations do not extend beyond the epi-marginal groove.

Dimensions—Largest diameter 114 mm. Respective widths of inner, median and outer zones along greatest radius: 20 mm., 17 mm., and 25 mm.

Discussions and comparisons—The specimen is considered to be the impression of the sub-umbrella surface of a "dried out" jellyfish. Organs adjacent the oral surface of the animal have come to stand out in relief, and the manubrium is preserved clearly. The central zone corresponds with the gastrovascular cavity and the gonads at the base of the manubrium are superimposed on it.

The sub-triangular manubrial structure has been so interpreted in view of its apparent fusion centrally with the sub-umbrella surface, and because no other comparable structures are distributed radially about the centre. The flattened attitude of this manubrium bears a superficial resemblance to the insert lobes of the central discs of *Kirklandia* (Caster) and *Rhizostomites* (Haeckel). However, the absence of more of these structures radially about the centre disputes this view. In life the manubrial structure would be suspended vertically from the central region (fig. 5). The shape of the mouth opening cannot be judged, although it was probably simple. On this impression the genus has been classified with the *Semaeostomeae* and not the *Rhizostomaeae*.

The three pendant pouches extending radially from the base of the manubrium are almost certainly gonads. Judging by their distribution there were probably eight of them originally.

Various concentric flutings, with the exception of that adjacent the margin of the form, are referable to the circular muscles of the sub-umbrella. The epi-marginal groove is the circular canal. The radial canals do not extend beyond it.

The well marked radial grooves of the median zone are probably radial canals. There is evidence of branching, and although the grooves are sub-parallel they do increase in number centrifugally. The grooves could be merely shrinkage creases, but in any case these would tend to follow such lines of weakness as canal lines.

Two marginal notches can be interpreted; they occur at intervals corresponding with the major radial canals. In each case deeper radial grooves continue to each notch. This would support the view that the notches are regular marginal features, possibly originally enclosing sensory structures. On the other hand, it is noted that in other portions of the fossil where continuous sections of the margin are preserved, other notches are not apparent. The observed notches could be accidental marginal invaginations due to deformation upon burial. There are no indications of marginal tentacles but they probably had dropped off previously.

Ediacaria is probably Scyphozoa. The form was large and obviously had a flattened disc-shaped umbrella and may be referable to either of the orders *Semaeostomeae* or *Rhizostomeae*. To decide further to which of these orders the form belongs, a detailed knowledge of the structure of the mouth and oral arms would be necessary. The incomplete preservation of the specimen precludes this. However, it is noticeable that the manubrial structure as interpreted is relatively simple suggesting relationship with the *Semaeostomeae*.

Comparison with other fossils is exceedingly difficult in view of the absence of many critical features. Closest resemblance is perhaps with *Rhizostomites* and *Semaeostomites* (both Haeckel) of the Upper Jurassic of Solnhofen, Bavaria. In these forms three concentric zones can be inferred but otherwise there is little similarity in available detail of the central disc regions. Ring muscles are well

developed in the outer portions of *Rhizostomites* as they are in *Ediacaria*. No obvious ring canal is present in *Rhizostomites* as in *Ediacaria* and *Semaostomites*, and whereas the margin of *Semaostomites* is split into 120-128 marginal lobes, such a subdivision is not apparent in the other two forms.

Genus *Tateana* Sprigg gen. nov.

Genotype *Tateana inflata* Sprigg gen. et sp. nov.

Pound Quartzite, Upper Adelaide Series (Lower Cambrian), Ediacara, South Australia.

Generic characters—Circular, slightly inflated medusa with very numerous unbranched radial canals. Well developed submarginal circular canal. Four or eight marginal notches. The genus is distinguished from *Cyclomedusa* (see later) by its more inflated surface and the presence of marginal notches.

Tateana inflata Sprigg, gen. et. sp. nov.

(Plate xi, fig. 1 and 2)

Holotype: No. 2017, Tate Mus. Coll. Adel. Univ., S. Aust.

Hypotype: No. 2018.

Description—Medusa circular, radially symmetrical, surface inflated slightly but with strong narrow radial striations; only very slight annulations can be distinguished.

The central zone (stomach) is simple and circular, representing one-third of the diameter of the complete form. The radial striations lead directly from the central zone to the epimarginal groove or circular canal. They do not appear to branch and number about 100. There is slight evidence of four or more marginal notches.

There is no sign of marginal appendages, manubrial structures or gonads.

Dimensions—Greatest diameter 6.4 mm.

Comparisons—The form has much in common with *Ediacara*, and may prove to be generically identical when more material is available for study. However, in *Ediacara* a tendency to branching in the radial canals has been noted. This is definitely not present in *Tateana*. In its unbranched radial canal system it approaches *Cyclomedusa* (see later under Medusoid problematica) more closely.

The decision to place this species in Semaostomeae rested on its similarities with *Ediacaria*.

Order RHIZOSTOMAE (Cuvier 1799)

Scyphozoa without marginal tentacles and with numerous mouths which are borne on adradial fleshy branched arm-like appendages which arise from the centre of the sub-umbrella. The lips of the numerous mouths are bordered by minute constantly moving tentacles.

All living species are tropical and few extend far into temperate waters. None are known from polar seas. The animals are usually tough and large and therefore are not uncommonly preserved in the fossil state.

Genus RHIZOSTOMITES Haeckel 1866

Genotype RHIZOSTOMITES AMIRANDUS Haeckel 1866

Solnhofen Slates Eichstadt, Bavaria

Generic characters (as defined by Brandt)—Disc as large as 0.4 metre, with 128 marginal lobes, without marginal tentacles; oral trunk rudimentary usually in the form of an oral disc, surrounded by eight arms. Genital cavities, four. Coelenteric central cavity simple, with sphero-quadratic roof. Mouth opening late, perhaps never completely obliterated, cruciform with eight branches.

Pseudorhizostomites howchini, Sprigg sp. nov.

(Plate xii, fig. 1; text fig. 6 F)

Holotype: 2034 Tate Museum, University of Adelaide, South Australia.

Locality: Pound Quartzite, Lower Cambrian, Ediacara, Australia. Coll. by R. Ayliffe.

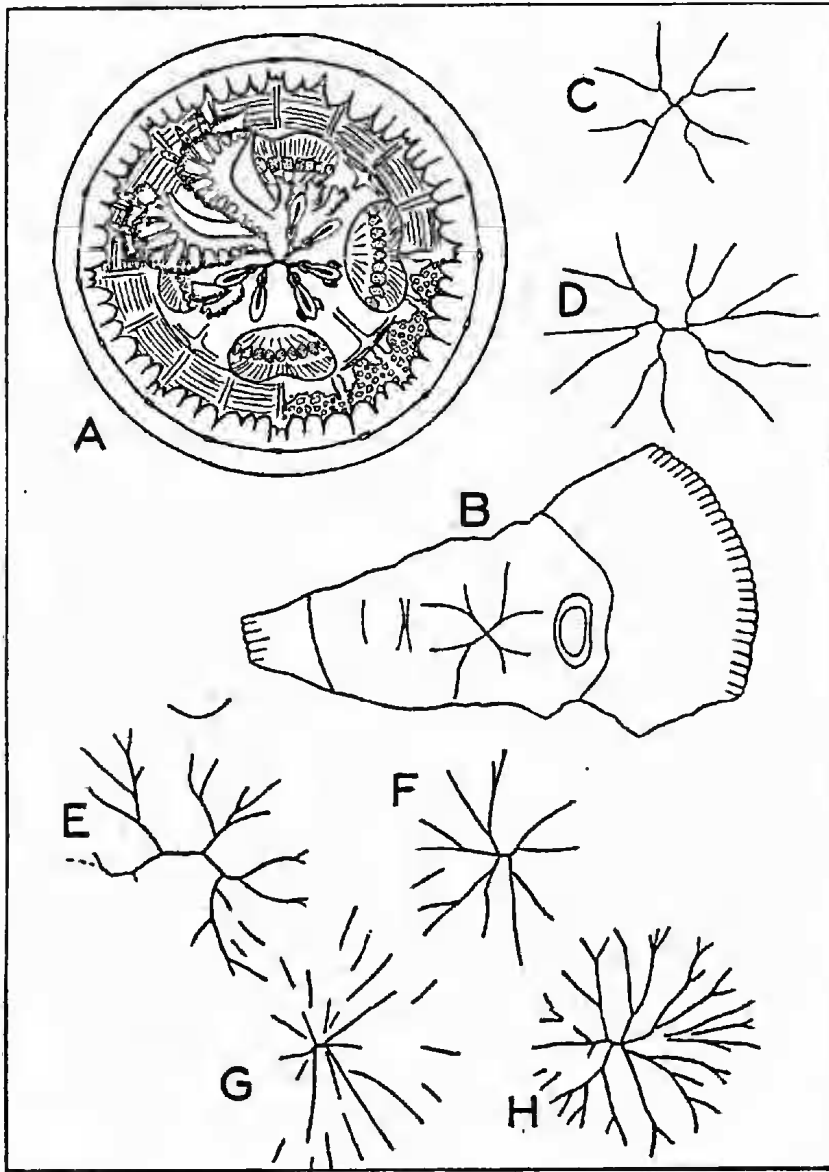


Fig. 6

A, *Rhopilema verrillii* (living); B, *Rhizostomites lithographicus* (Jurassic);
 C, *R. amirandus* (J.); D, *Hexarhizites insignis* (J.); E, *Pseudarhopilema
 chapmani*; F, *Pseudorhizostomites*; G and H, *Pseudorhizostomites* sp.

Description—Impression convex, with cruciform radial grooves each branching simply once. The grooves alternatively cut off concave and convex isoscelean areas. There is a slight suggestion of secondary dichotomous branching at the end of one or more of the eight subradial grooves.

Dimensions—Total width of form 30 mm.

Discussions and comparisons—The four areas divided off by the secondarily branched furrows are interpreted to be the basal portion of the four great oral

arms, or branches of the gastral trunk which hangs down from the centre of the umbrella cavity of scyphozoans. The grooves are the lines of fusion formed during the coalescence of lips of the primitive central mouth of the juvenile form. In this way the primitive central mouth has been obliterated in *Rhizostomeae*, but numerous other mouth-openings remain in the gutter-like grooves which extend down the ventral sides of the mouth arms.

Specimen No. T116 (pl. xii, fig. 3 B; text fig. 6 G) may also be referable to this genus, although the number of primary grooves is somewhat excessive, and the dichotomous branching is essentially restricted to the immediate mid-field. In specimen 2043 (pl. xii, fig. 3 A; text fig. 6 H), on the other hand, dichotomous branching is very pronounced. In view of the problematic nature of these fossils there has been no attempt to make specific subdivisions.

Genus *Pseudorhopilema* Sprigg gen. nov.

Pseudorhopilema chapmani Sprigg, gen. et. sp. nov.

Pound Quartzite, Upper Adelaide Series (Lower Cambrian), Ediacara, South Australia.

As the form is known only from the very limited detail of its central field, generic characters tentatively will be taken to include the inferred presence of eight oral arms and associated paired (?) scapulets.

Pseudorhopilema chapmani Sprigg, gen. et. sp. nov.

(Plate xii, fig. 2; text fig. 6 E)

Holotype: No. 2036, Tate Mus. Coll., Adel. Univ., Coll. P. Healy.

Description—Midfield slightly convex with a central groove or furrow giving rise to a system of dichotomously branched primary, secondary and perhaps tertiary grooves.

Dimensions—Length of median furrow 7 mm. Width of central disc., as indicated by extension of scapulets, 50 mm.

Comparisons—The form bears definite relations with the restricted central portion of the well known Jurassic forms (fig. 6) *Rhizostomites amirandus* and *R. lithographicus* (both Haeckel 1866). Obvious differences concern the strong development of a central furrow and of the presence of tertiary dichotomously branched furrows. *R. lithographicus* approaches the newly described form more closely in that it has a small single central groove which imparts a minor tendency towards bilateral symmetry as against the simple cruciform character of *R. amirandus*.

Assuming that the form was typical of modern and fossil *Rhizostomae*, there would have been eight oral arms. But the form has 16 tertiarily branched dichotomous grooves, and these are thought to correspond with the canals or ducts of scapulets which normally arise from the sides and near the bases of each of the oral arms.

A more complete comparison in so far as this is possible is with the living form *Rhopilema verrillii* (Haeckel). In this form both the strong central furrow and the scapulae are present (fig. 6 A), and in a general sense the restricted detail in the two cases is very similar.

MEDUSOID PROBLEMATICA

Category MEDUSINA Walcott 1898

Walcott erected this Category (calling it a genus) to include all species of fossil medusae whose generic characters cannot be determined. It is now suggested that the idea of "genus" be dissociated from the term and for *Medusina* to be considered as a category of convenience for such medusoid forms. This

would provide for the development of some broader classification within the category and enable the use of new "generic" names additional to *Medusina*. Apparent relationships could be made more obvious in this way.

Medusina mawsoni Sprigg, sp. nov.

(Plate xiii, fig. 4; text fig. 7 B)

Holotype: No. T. 39, Tate Mus. Coll., Adel. Univ., S. Aust.

Type Locality: Pound Quartzite, Lower Cambrian, Ediacara, S. Aus.

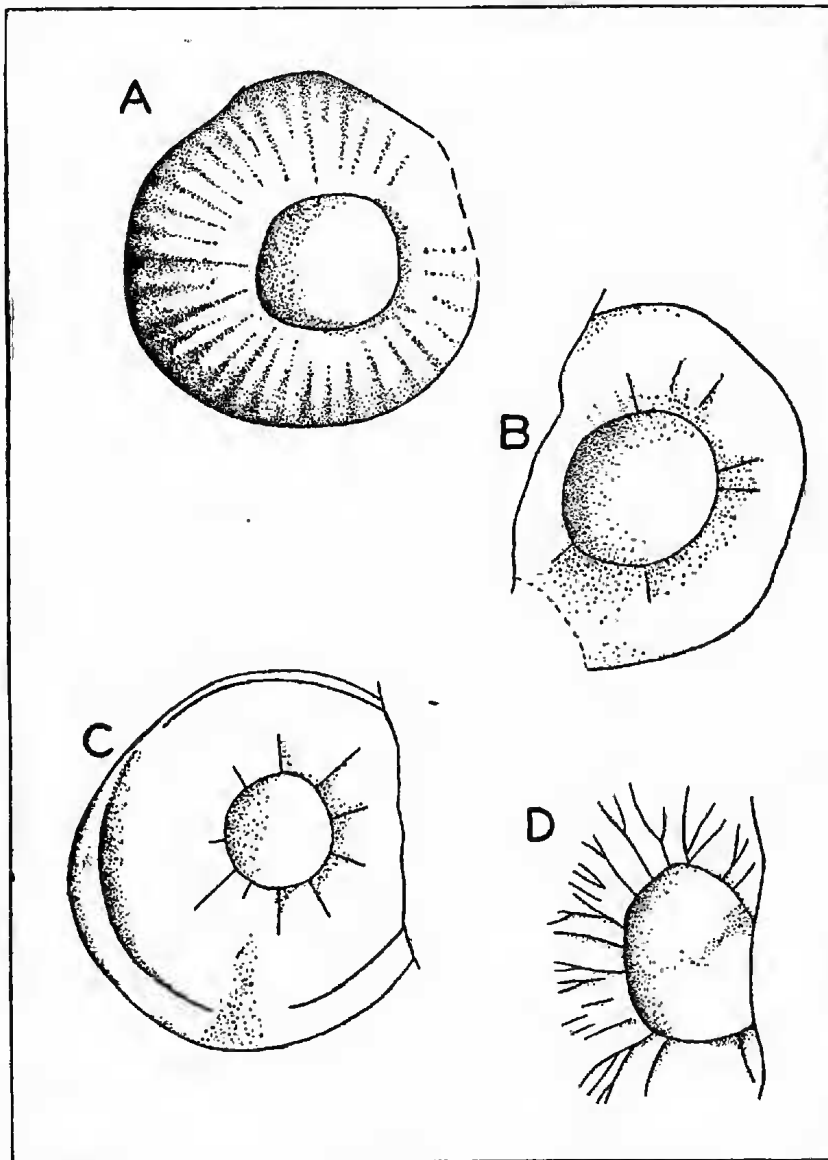


Fig. 7

A, *Medusina radiata* (L. Cambrian, Bohemia);
B, *M. mawsoni*; C, *M. asteroides*; D, *M. filamentus*.

Description—Impression circular, medusoid; central area depressed, circular and convex, occupying between one-third and one-half the full diameter. The outer annular zone is inflated centrally and there is a suggestion of radial ridges within the zone at close intervals. Margin simple, circular. No evidence of marginal appendages.

Discussions and comparisons—The form is obviously the fossil of a medusoid coelenterate. The central depressed area may correspond with a collapsed stomach area, and the indefinite radial structures of the outer zone with radial canals.

The specimen has much in common with Pompeckj's *Medusina radiata*? of the Bohemian Lower Cambrian (fig. 7 A). The radii in the present specimen are faintly and very incompletely preserved and it is impossible to tell whether they are branched as in Pompeckj's specimen. The latter had 75 to 80 radii at the outer margin.

The writer feels that the tentative identification of Pompeckj's specimen with Linnarsson's *Medusina* (= *Astylospongia*) *radiata* is unsatisfactory. Pompeckj (1896) notes that it agrees only in a general way and that some differences forbid its direct identification with the original Swedish form. "The string-of-pearls shape of radii, already noted by Linnarsson, cannot be observed, and the number of radii in the Bohemian specimens is less than in Linnarsson's species." The intervals between the radii are larger in Pompeckj's specimen. It is felt, therefore, that *M. Mawsoni* may be synonymous with *M. radiata*? of Pompeckj.

Dimensions—Diameter of complete form 2.7 mm.; diameter of central depressed area 1.7 mm.

***Medusina asteroides* Sprigg sp. nov.**

(Plate xiii, fig. 3; text fig. 7 C)

Holotype: No. 2021, Tate Mus. Coll., Adel. Univ., S. Aust.

Type Locality: Pound Quartzite, Lower Cambrian, Ediacara, Flinders Ranges, South Australia.

Description—Impression circular, slightly inflated, central disc occupying approximately one-quarter of the diameter of the complete form and surrounded by a deep groove. The surrounding zone has an epimarginal groove and is traversed by widely spaced radiating grooves dispersed in an (?) octagonal pattern. Not all radii continue to the epimarginal groove. There are no visible marginal appendages.

Dimensions—Greatest diameter 24 mm.; diameter of the central disc 10 mm.

Dimensions and comparisons—The depressed central area may represent a collapsed stomach; the radial grooves are radial canals and the epimarginal groove corresponds with a circular or ring canal. In view of an absence of restricting critical features, and simple circular form, it is referred to the genus *Medusina*. It differs from *Medusina radiata* and *M. Mawsoni* in the possession of fewer radii and a relatively small central depressed area.

***Medusina filamentus*, Sprigg spec. nov.**

(Plate xiii, fig. 1; text fig. 7 D)

Holotype: No. T68, Tate Mus. Coll., Adel. Univ., S. Aust.

Type Locality: Pound Quartzite, Lower Cambrian, Ediacara, S. Aust.

Description—Impression ovoid, inflated. Thirty to forty filamentous (?) tentacles are given off at fairly regular intervals around the (complete) margin. The tentacles frequently appear to branch at least once half-way along their respective lengths which are only slightly shorter than the diameter of the fossils.

Affinities—The writer knows of no similar fossil form. Apart from the inflated medusoid form and marginal (?) tentacles restricting features are absent.

Dimensions—Maximum and minimum diameters 22 and 16 mm. respectively. Average length of tentacular processes 10 mm.

Genus *Cyclomedusa* SpriggGenotype *Cyclomedusa davidi* Sprigg

Generic characters—Ex-umbrella sculptured by fairly prominent concentric grooves which may or may not extend to the margin, and numerous fine simple unbranched radial striations. The radial striations do not continue into the circular zone which may or may not contain a central nodular structure. The margin is simple and an epimarginal groove is present in well-preserved specimens.

KEY TO SPECIES

- C. davidi* - - prominent annular grooves extend to the margin.
C. radiata - - outer zone essentially free of annular grooves.
C. gigantea - - large form, inner and outer zones divided by a deep annular groove. Radial striations extremely numerous.

Cyclomedusa davidi Sprigg

(Plate xiv, fig. 1, 2 and 4; text fig. 8)

Holotype: No. T 5, Tate Mus. Coll. Adel. Univ., S. Aust.

Hypotypes: Nos. 2020, 2040.

Description—Impression circular, flattened, and with concentric undulations. The form exhibits striking radial symmetry and its surface is subdivided by at least seven annular grooves. Central portion raised, distinctly nodular.

The original specimen (T 5) was known to be incomplete. Three zones were recognised, the inner being hemispherical and nodular and 5 mm. in diameter and 1.5 mm. in height. The outer two zones were of lower relief; annular portions within these were traversed alternately by radial striations (? radial canals) or were apparently free of sculpture. The form as preserved indicated a maximum radius of 50 mm. and there appeared to be about 16 radial striations per quadrant.

A newer, better preserved specimen considered to be specifically identical exhibits essentially similar characters, except that it appears that the radial striations are continuous through the various subdivisions of the outer zone. They therefore would continue uninterruptedly from the central (?) stomach region to the margin of the form. A more critical examination of the holotype specimen has indicated a degree of agreement in this respect.

Dimensions—Overall diameter of specimen No. 2020 is 52 mm.

Reproduction—Specimen 2040 at first appearance has the suggestion of a flattened tabulate colonial pleospongian. Dr. Okulitch and others who have seen photos of this specimen have recorded this impression on first viewing it. However, the fossil is more or less identical with accepted specimens of *C. davidi* except for its peculiar constrictions. It is felt that the constriction may be part of an irregular budding process in which the two daughter medusae each possess adult characters. If this is a reliable interpretation, it seems to be another unique method of reproduction amongst jellyfish. It is also remotely possible that the animal may have been damaged and that the irregular form is completely fortuitous. Fission has produced three segments in all, and two differ only slightly in width, while the third is significantly smaller.

A rather parallel but not identical case of reproduction by fission occurs in *Gastroblasta* (Keller). *Gastroblasta raffaelei* (Lang), for example, is slightly elliptical and possesses four manubria. According to Mayer (1910) "the medusa frequently reproduces by fission and the plane of division is at right angles to the long axis of the ellipse and passes between the oldest and next oldest Manubrium.

When about to divide, the oldest lithocyst divides into two and the cleft proceeds inward at this point until the medusa is completely cut into halves, the one being a reflection of the other. Each then develops new radial-canals budding from the ring-canal and growing inward. When the original form has been restored a new fission may take place. This is not a constant process, however, but is subject to much variability, for new radial canals may grow inward from the ring-canal in the regions of the old tentacles, and these new canals may fuse with the old canal-system and develop manubria."

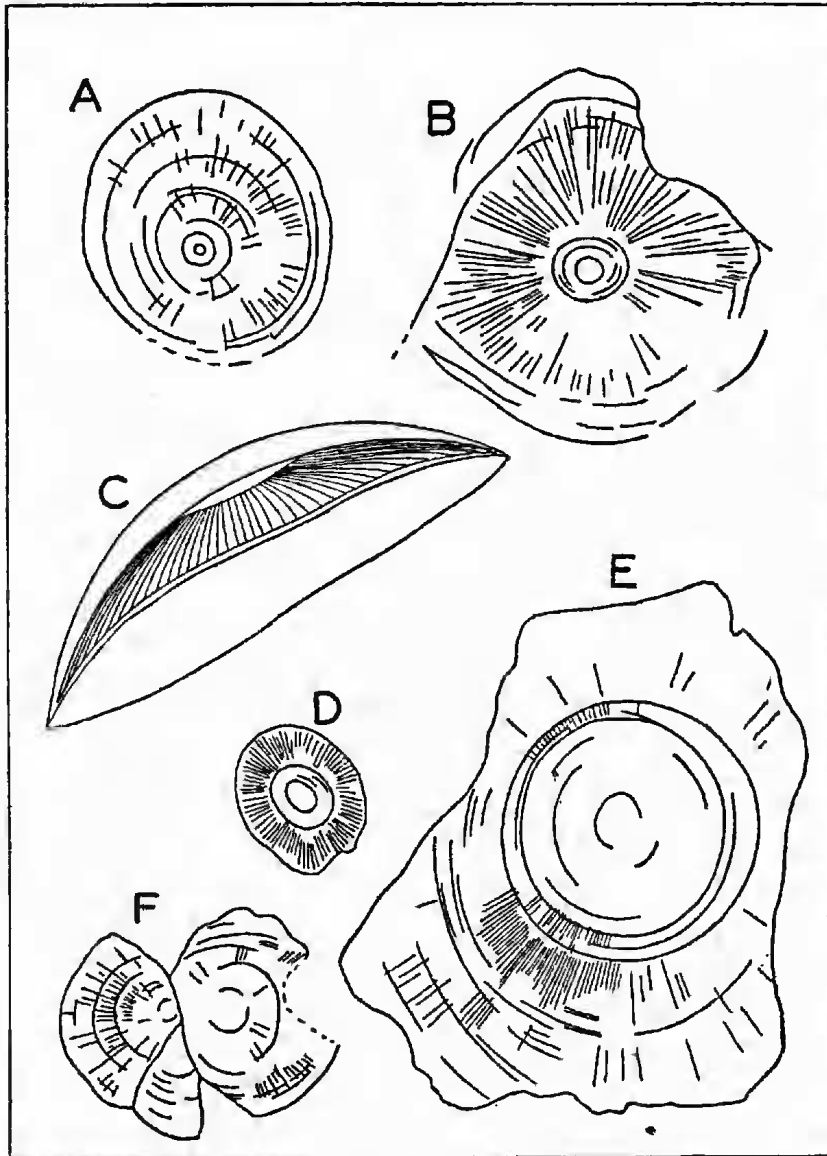


Fig. 8

A, *Cyclomedusa davidi*; B, *C. radiata*; C, reconstruction of *Cyclomedusa*; D, juvenile form; E, *C. gigantea*; F, *C. davidi* in process of fission.

The occurrence of irregular transverse fission of this nature elsewhere in the kingdom of medusae greatly strengthens the view that the restrictions in the aberrant specimen of *Cyclomedusa davidi* have generative significance.

Cyclomedusa radiata Sprigg sp. nov.

(Plate 13, fig. 2; plate xiv, fig. 3; plate xv, fig. 1; plate xviii, fig. 1, text fig. 8)

Holotype: No. 2037, Tate Mus. Coll., Adel. Univ., S. Aust.

Hypotypes: Nos. 2010, 2032, 2027.

Description—Species similar to *C. davidi*, except in that the outer zone is practically free of annular grooves. Radial striations are continuous and prominent in the outer zone.

In specimen 2039 the central (?) stomach zone is relatively narrow, with a central node surrounded by two or three concentric grooves. In radial relation the outer zone is three times the width of the inner. It is traversed by numerous radial striations, and 50 of these can be recognised clearly in one half of the fossil; the striations do not appear to branch and all appear to join the central zone separately. They connect with an epimarginal groove or (?) ring canal at their distal ends. The margin appears to be simple.

Specimens 2032 and 2027 are essentially similar but differ in that the ratio of the radial widths of the inner and outer zones is approximately 1:1. 2032 is apparently a juvenile form of 2027. Neither of these exhibit an obvious circular canal.

Cyclomedusa gigantea Sprigg sp. nov.

(Plate xv, fig. 2; text fig. 8 E)

Holotype: No. 2035, Tate Mus. Coll.; Adel. Univ., S. Aust.; Coll. R. Ayliffe.

Descriptions—Form essentially similar in many aspects to *C. davidi* and *C. radiata*. There are two zones, the inner of which is devoid of radial striations, whereas they occur weakly in the outer one; the complete form possesses numerous concentric groovings.

The central zone is separated from the outer by an unusually deep sulcus or groove. The margin of the animal is incomplete and ill-defined. In the complete form there would be approximately 200 simple, unbranched radial grooves. These are much more numerous than in *C. davidi* (approximately 50) or *C. radiata* (approximately 100).

Dimensions—Overall diameter greater than 65 mm.; (?) stomach 42 mm. in diameter.

Discussion and comparisons—The foregoing three species have much in common and separation is rather arbitrary on this account. Nevertheless there appears to be some regularity in variation in surface sculpture which it is thought merits specific subdivision.

The anatomical organisation of the animals is unknown except by inference. The central zone, which is free of radial ornamentation, probably delimits the stomach. The significance of the radial grooves is open to argument but their interpretation as radial canals is probably justifiable. If so, these canals were simple and unbranched and mostly continuous from the stomach to the circular canal. The form differs from *Ediacara* in this feature.

The fossils may be discoid Scyphozoans, but such classification is too optimistic for the present.

Genus Madigania Sprigg gen. nov.Genotype: **Madigania annulata** Sprigg gen. et sp. nov.

Pound Quartzite: Upper Adelaide System (Lower Cambrian), Ediacara, S. Aust.

Generic characters—Circular form with numerous conspicuous annular grooves, ridges or undulations. No radial ornamentation. It may or may not have a central conspicuous papilla or node.

Madigania annulata Sprigg gen. et sp. nov.

(Plates xvi, fig. 1 and 2; plate xvii, fig. 1 and 2)

Holotype: No. 2031, Tate Mus. Coll., Univ. Adel., S. Aust.

Hypotypes: 2025, and T9 and T14.

Descriptions — Impression circular, with numerous conspicuous annular undulations. Essentially flat; margin simple.

Specimen 2031 has a very conspicuous central papilla, but this is suppressed or poorly developed in the other specimens.

There is no evidence of radial canals, marginal appendages or notches, gonads or manubrial structures. The stomach cannot be defined.

T9 is the largest fossil medusa yet found at Ediacara, its greatest radius is 110 mm.

Diameter of holotype, 170 mm.

Comparisons—As the genus is founded solely on rather irregular cyclic surface sculpture useful comparison with other living or fossil forms is practically impossible. The annular undulations may reflect musculations in the umbrella of a medusa.

As in the case of *Cyclomedusa* it is impossible to be certain whether *Madigania* is Scyphomedusan or Hydromedusan. It differs from *Cyclomedusa* in that there are no conspicuous radial striations.

Genus *DICKINSONIA*, Sprigg 1947

The affinities of the fossil group which will now be described are extremely uncertain. Practically nothing is known of the anatomy of the fossils concerned, and diagnostic characters are restricted to the possession of a strong bilateral symmetry, an elliptical form, numerous radial grooves, a submarginal groove marking off a flange, and a median furrow.

The fossils may well belong to an extinct order or class, but until more is known of the group no attempt will be made to erect any such new categories. Obscure relations with some of the jellyfishes could be argued, as some have a tendency towards bilateral symmetry, and the possession of radiating (?) canals is a strong feature.

The presence of a well-developed bilateral symmetry may indicate higher specialisation and organisation, and perhaps the assumption of creeping habits. Bilateral symmetry is a common characteristic of the Siphonophora and the fossils in question may eventually be referred to that Order. However, for the present, even the assumption that they are Coelenterate may be questionable, but considering their geological age, their mode of occurrence and the few obvious details of their organisation, the coelenterate category seems the most logical association for the present.

Genus *Dickinsonia*, Sprigg 1947Genotype: *Dickinsonia costata* Sprigg 1947

The genus was founded on a single ovoid form which possessed a marginal crenulate flange and a median longitudinal furrow giving off very numerous sub-radial grooves to the outer crenulate margin. The form was considered to be inflated aborally in life.

Since describing this form much new material is available from the same horizon with which to make comparisons and study variation. Variation has been found to be considerable while still preserving the same general form. The major differences concern the shape of the fossil and prevalence of radial grooves. It was felt that shape alone is insufficient evidence of specific variation, especially in view of the distortion which some forms have suffered and the probability that organisms in various stages of development are being dealt with.

To overcome these complications, it was felt by plotting the radial grooves in either symmetrical half of the individual animals against respective overall dimensions, that some clearer relations might show up. This has been the case, and a fairly direct relation is seen to exist between growth stage and the number of radial grooves. All the specimens form into two series (fig. 9) which it is

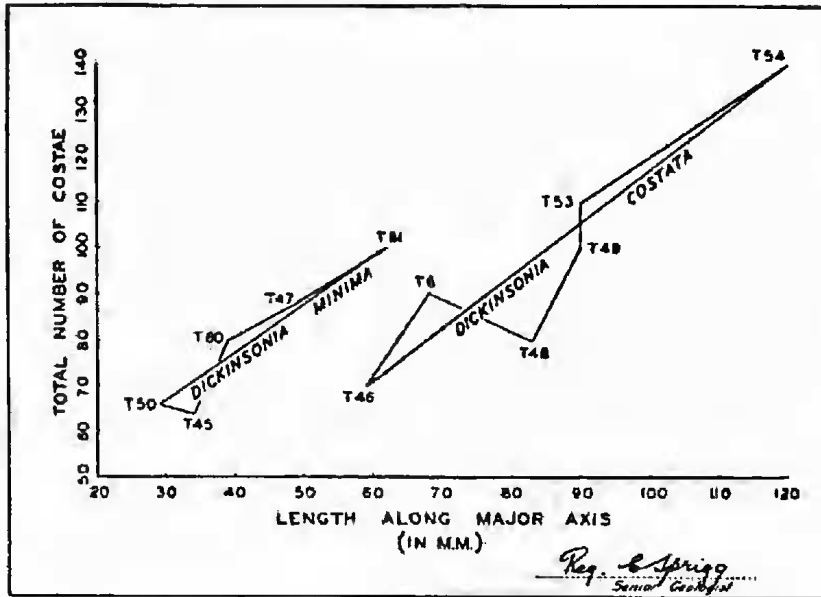


Fig. 9

assumed relate to specific differences. One series indicates less density of costae per unit length and, without exception, includes the larger specimens. It includes the genotype specimen *Dickinsonia costata*. The alternate series has been named *Dickinsonia minima*.

Dickinsonia costata—Length 60-120 mm.; 70-140 costae.

Dickinsonia minima—Length less than 60 mm.; 60-100 costae.

Dickinsonia costata Sprigg 1947

(Plate xviii, fig. 2; plate xix, fig. 1 and 2; plate xx, fig. 1 and 2, text fig. 9 and 10)

Holotype: No. T5, Tate Museum Coll. Adel. Univ., S. Aust.

Hypotypes: 2050, 2012, 2004, 2007, 2009.

Description—Impression ovoid, bilaterally symmetrical, essentially flat; median longitudinal furrow approximately 35 mm. long gives off 70-140 radiating or diverging grooves or costae (?) alternatively to the margin of the fossil. Margin slightly crenulate when complete, the notches corresponding with the intersection of the radiating grooves. There is a definite crowding of costae towards one end in several specimens. This could be related to a specialisation leading to the development of an anterior end, or simply to distortion during burial. The well developed concentric epi-marginal sulcus in the holotype specimen marks off a marginal flange. In other specimens the flange is absent or weakly developed.

Variation—The smallest specimen of the series (pl. xix, fig. 2) exhibits characters not seen in the others. It is (?) deformed with the production of annular folds. The character is thought not to be of anatomical or morphological significance.

Certain of the specimens show considerable variation in their length over breadth ratios. Specimens 2012 and 2009 for example are exceedingly broad, whereas 2007 is at first sight much narrower. This apparent important difference is resolved however upon the closer inspection of specimen 2007. The deeper costae of the central region cut out relatively sharply away from the central plane of symmetry, but finer grooves of somewhat different type continue considerably further. These fainter lines are quite similar to the radial sculpture of 2012. It

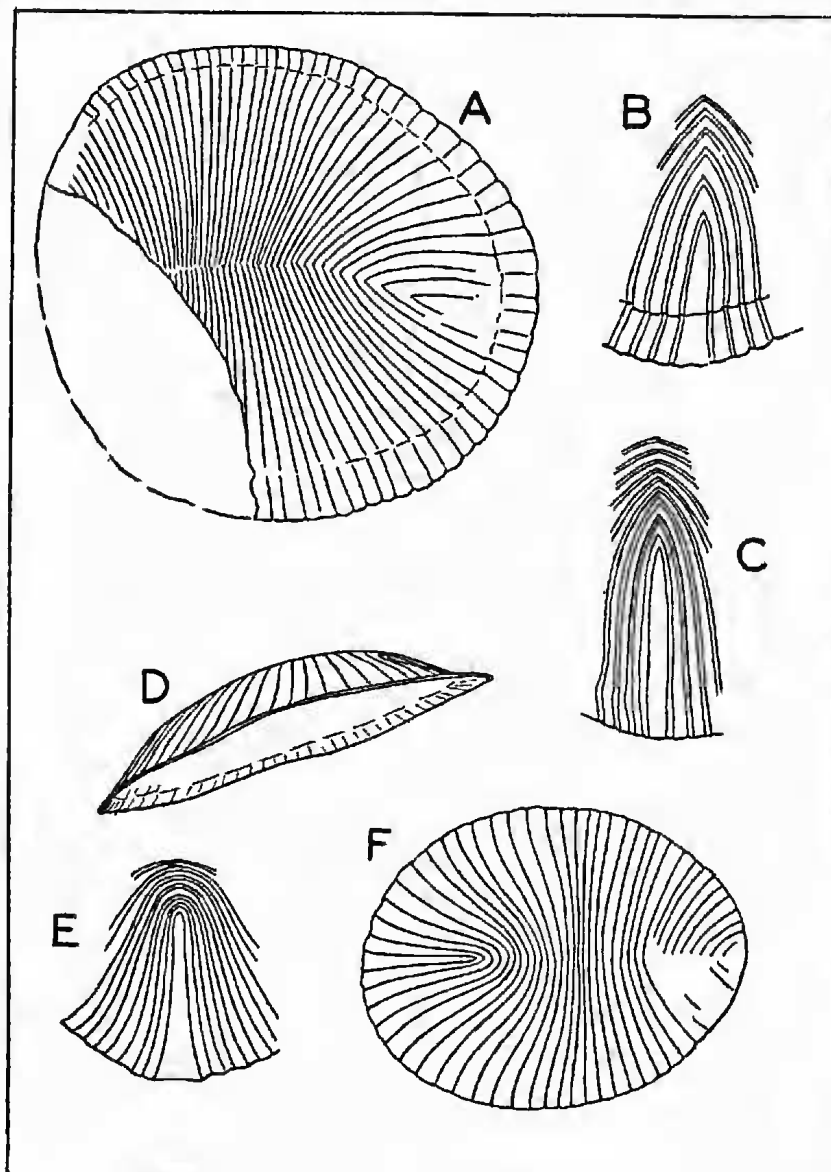


Fig. 10

A, B and C, *Dickinsonia costata*; D, reconstruction of *Dickinsonia*; E. and F, *D. minima*.

would appear moreover that the latter sculpture is more of a skeletal nature—perhaps representing chitinous rods. The coarser sculpture would appear to be more of surface significance. In this way there is a complete relationship between the apparently different fossils 2009 and 2012.

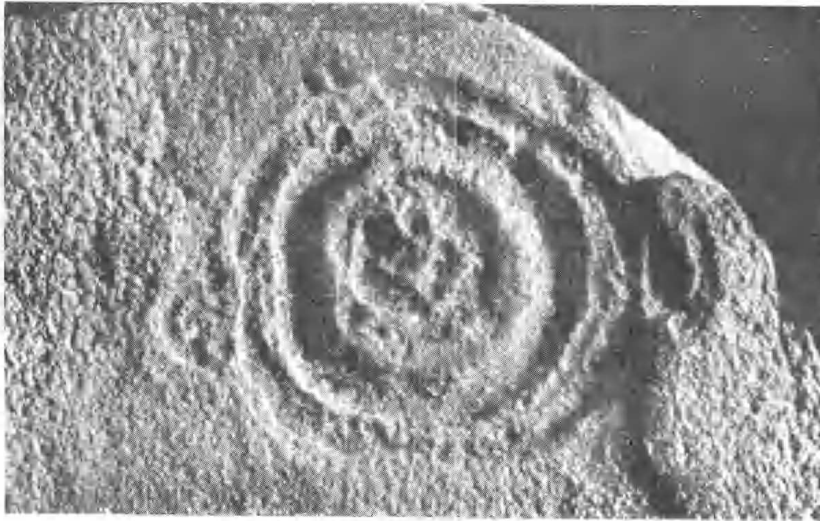


Fig. 1 *Protoniobia wadea*, Sprigg

Holotype No. 192, Commonwealth Palaeontological Collection, Canberra, F.C.T. Specimen collected by Dr. A. L. Wade from Lower Cambrian flags, Mount John Osmond Range, Western Australia. The impression occurs on the bedded surface of laminated sandstone.



Fig. 2 *Protodipleurosoma wardi*, Sprigg

Holotype No. 2023, from the Lower Cambrian "Pound" Sandstone-quartzite at Ediacara, South Australia. This specimen and others figured below occur as impressions in fissile flaggy and poorly laminated quartzites.



Fig. 1 *Beltanella gilesi*, Holotype No. 2056



Fig. 2 *Ediacaria flindersi*, Holotype No. 2058



Fig. 1 *Talcana inflata*, Holotype No. 2017



Fig. 2 *T. inflata*, Specimen No. 2018